

**CRASH DATA RESEARCH CENTER**

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**CALSPAN ON-SITE AMBULANCE CRASH INVESTIGATION**

**SCI CASE NO.: CA12032**

**VEHICLE: 2009 CHEVROLET C4500 / ROADRESCUE TYPE I AMBULANCE**

**LOCATION: NEBRASKA**

**CRASH DATE: JULY 2012**

Contract No. DTNH22-07-C-00043

Prepared for:

U.S. Department of Transportation  
National Highway Traffic Safety Administration  
Washington, D.C. 20590

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points are coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

## TECHNICAL REPORT STANDARD TITLE PAGE

<b>1. Report No.</b> CA12032	<b>2. Government Accession No.</b>	<b>3. Recipient's Catalog No.</b>	
<b>4. Title and Subtitle</b> Calspan On-Site Ambulance Crash Investigation Vehicle: 2009 Chevrolet C4500/RoadRescue Type 1 ambulance Location: Nebraska		<b>5. Report Date:</b> November 2012	
		<b>6. Performing Organization Code</b>	
<b>7. Author(s)</b> Crash Data Research Center		<b>8. Performing Organization Report No.</b>	
<b>9. Performing Organization Name and Address</b> Calspan Corporation Crash Data Research Center P.O. Box 400 Buffalo, New York 14225		<b>10. Work Unit No.</b>	
		<b>11. Contract or Grant No.</b> DTNH22-07-C-00043	
<b>12. Sponsoring Agency Name and Address</b> U.S. Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590		<b>13. Type of Report and Period Covered</b> Technical Report Crash Date: July 2012	
		<b>14. Sponsoring Agency Code</b>	
<b>15. Supplementary Note</b> An investigation of the intersection crash and subsequent rollover of a 2009 Chevrolet C4500 / RoadRescue Type I ambulance operating in an emergency mode (with lights and siren activated).			
<b>16. Abstract:</b> This on-site investigation focused on the intersection crash and rollover of a 2009 Chevrolet C4500 chassis with RoadRescue Ultramedic Type I ambulance body. The vehicle was configured with a forward cab and a rear patient compartment equipped for the treatment of medical emergencies in a mobile environment. It was traveling north while transporting a patient who was involved in a separate traffic crash to a local hospital for an unknown medical problem. An on-going construction project on the physically-divided, four-lane roadway restricted traffic flow to two lanes. As the ambulance approached an intersection while utilizing its emergency warning lights and siren, the electronic traffic control signal cycled to control northbound and southbound traffic. A dump truck traveling west on the intersecting road yielded to the ambulance. A 2012 Ford Fusion, which was traveling west behind the dump truck, did not yield to the ambulance and proceeded into the intersection to turn right. The ambulance driver also proceeded into the intersection in response to the dump truck providing the right of way. The right aspect of the ambulance's frontal plane impacted the forward aspect of the Ford's left plane. The ambulance then impacted and rode up onto the concrete median barrier, initiating a right side-leading, one quarter-turn rollover. A post-crash fire ensued, and all four occupants of the ambulance were transported to a local hospital for treatment of their injuries.			
<b>17. Key Words</b> Ambulance      Rollover      Emergency Mode      Stretcher		<b>18. Distribution Statement</b> General Public	
<b>19. Security Classif. (of this report)</b> Unclassified	<b>20. Security Classif. (of this page)</b> Unclassified	<b>21. No. of Pages</b> 49	<b>22. Price</b>

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## CALSPAN ON-SITE AMBULANCE CRASH INVESTIGATION

SCI CASE NO.: CA12032

VEHICLE: 2009 CHEVROLET C4500 / ROADRESCUE TYPE I AMBULANCE

LOCATION: NEBRASKA

CRASH DATE: JULY 2012

### BACKGROUND

This on-site investigation focused on the intersection crash and rollover of a 2009 Chevrolet C4500 chassis with RoadRescue Ultramedic Type I ambulance body (**Figure 1**). All four occupants of the ambulance were transported to a local hospital for reported minor injuries. The crash was identified by the National Highway Traffic Safety Administration's (NHTSA) Office of Emergency Medical Services (OEMS), which provided notification to the Crash Investigation Division (CID). The CID



**Figure 1:** Involved ambulance at final rest (image obtained from a local news source).

forwarded notification to the Special Crash Investigations (SCI) team on Friday, July 13, 2012. SCI initiated contact with the investigating County Sheriff, and cooperation was established on July 16, 2012 to perform an on-site inspection of the ambulance at impound on July 17, 2012. The on-site portion of this investigation consisted of the detailed inspection and documentation of the ambulance and crash site, with interviews of the ambulance agency's administration and the Emergency Medical Services (EMS) crewmembers involved. The Chevrolet was not equipped with an EDR, as it did not have any supplemental restraint systems. Also inspected was a 2012 Ford Fusion involved in the crash. During the inspection process, the Ford's Event Data Recorder (EDR) was imaged.

The Chevrolet C4500 chassis was configured with a forward cab and a rear patient compartment equipped for the treatment of medical emergencies in a mobile environment. It was traveling north while transporting a patient who was involved in a separate traffic crash to a local hospital for an unknown medical problem. An on-going construction project on the physically-divided, four-lane roadway restricted traffic flow to two lanes. As the ambulance approached an intersection while utilizing its emergency warning lights and siren, the electronic traffic control signal cycled to control northbound and southbound traffic. A dump truck traveling west on the intersecting road yielded to the ambulance. The Ford, which was traveling west behind the dump truck, did not yield to the ambulance and proceeded into the intersection to turn right. The ambulance driver also proceeded into the intersection in response to the dump truck providing the right of way. The right aspect of the ambulance's frontal plane impacted the forward aspect of the Ford's left plane. The ambulance then impacted and rode up onto the concrete median barrier and initiated a right side-leading, one quarter-turn rollover. A post-crash fire ensued, and all four occupants were transported to a local hospital for treatment.

## CRASH SUMMARY

### *Crash Site*

The crash occurred at the intersection of a two-lane roadway with a multi-lane, physically divided roadway. The multi-lane roadway was oriented in a north-south direction and physically divided by a depressed grass median. Ongoing construction to the multi-lane roadway restricted traffic flow to two lanes by channeling northbound traffic to the southbound portion of the roadway, creating a two-lane roadway. This construction zone was in place for a significant period of time prior to the crash, based on visible progress of the project and the semi-permanent placement of physical division for the travel lanes that consisted of vertical polymer posts south of the intersection and a raised concrete barrier north of the intersection. The temporary lanes were 3.7 m (12.1 ft) wide and delineated by a double-solid yellow centerline with 5 cm (2 in) diameter reflective polymer tubular posts. South of the intersection, the northbound portion widened for 44 m (144.4 ft) to include a 3.8 m (12.5 ft) wide left-turn-only lane at the intersection.

North of the intersection, the travel lanes were physically divided by a concrete barrier. This barrier began 20.8 m (68.2 ft) north of the east intersecting leg's northern roadway edge. The barrier was protected by approximately 13 impact attenuator sand barrels, which occupied 9.4 m (30.8 ft) of the median prior to the barrier's end. The northbound lane also widened to 4.5 m (14.8 ft) in the north leg of the intersection, and there was no shoulder to support it. A northbound trajectory view of the ambulance's travel path is depicted in **Figure 2**.



**Figure 2:** North-facing view of the ambulance's pre-crash trajectory and the construction zone.



**Figure 3:** West-facing view of the Ford's pre-crash trajectory.

The dump truck and Ford traveled west toward the intersection. Both lanes of the east leg were 4.5 m (14.8 ft) wide and delineated by a double-solid yellow centerline. **Figure 3** depicts a view of the vehicles' westbound trajectory toward the intersection. The Speed was regulated in all directions by a posted limit of 80 km/h (50 mph). A Crash Diagram is included on page 19 of this technical report.

## **CRASH SUMMARY**

### ***Pre-Crash***

The ambulance approached the intersection while operating in an emergency mode (with its warning lights and siren activated). This mode of travel was necessitated by the nature and condition of the female patient being transported, who had been in a separate traffic crash earlier that day. For its travel path, the intersection was controlled by an electronic traffic signal that cycled to “red” as the ambulance approached. The 71-year-old male driver of the ambulance recognized the traffic control’s cycle and applied the brakes. He slowed the vehicle to a negligible idle speed and approached a complete stop while waiting for all traffic within and approaching the intersection to yield and provide him with the right of way.

At the same time, an uninvolved dump truck traveling westbound entered the intersection. Its driver observed the ambulance and responded by applying the brakes and bringing the dump truck to a controlled stop. In effect, the dump truck stopped partway into the intersection and yielded the right of way to the ambulance due to its use of emergency warning lights and siren. The dump truck’s driver provided him the right of way, and with all other visible traffic having also yielded, the driver of the ambulance accelerated into the intersection while operating in an emergency mode.

The Ford traveled westbound on approach to the intersection. Its 56-year-old male operator observed the dump truck stopped within the intersection. Intending to turn right and travel north, he steered the Ford around the dump truck’s right side and initiated a right turn within the intersection. In response to the “green” status of the electronic traffic signal for his travel direction, and in lieu of not seeing the ambulance’s warning lights or hearing its audible siren, he did not stop or yield as he traveled through the intersection.

Due to the size of the dump truck, the ambulance’s driver did not see the Ford’s movement around the dump truck’s right plane until it initiated the right turn into his travel path. In response to the Ford’s encroachment, the driver of the ambulance unsuccessfully provided left steering and braking input in an attempt to avoid a collision.

### ***Crash***

The first crash event occurred as the right aspect of the ambulance’s frontal plane impacted the forward aspect of the Ford’s left plane within the northeast intersection quadrant. Sideswiping impact forces, in combination with the driver’s attempted avoidance input, redirected the ambulance left toward the center aspect of the north intersection leg. The Ford, its front wheels already aligned with a positive angle due to its turning status, maintained a right-arching trajectory. It departed the east roadway edge immediately north of the northeast intersection quadrant and proceeded to final rest within the construction zone.



**Figure 4:** View of the northbound lane and Event 1 impact location (tire mark in center of image).

Continuing its forward travel, the ambulance's frontal plane approached the physical concrete division barrier that had been installed for the duration of the roadway construction project. The ambulance's frontal plane contacted multiple impact attenuator sand barrels placed as the end treatment of the barrier (Event 2, **Figure 4**). Impact forces deflected and displaced the sand barrels as the ambulance maintained its forward trajectory. The ambulance's frontal plane then contacted and overrode the end of the concrete barrier (Event 3).

While maintaining forward movement, the ambulance straddled the barrier. During this sequence, the ambulance's front axle sheared from its suspension mounts and was displaced rearward. The right front tire then engaged the saddle compartment housing the low-voltage batteries, which partially separated the compartment from its chassis mounts. As the ambulance maintained its trajectory, the front axle completely separated from the chassis. Subsequently, the ambulance initiated a right side-leading rollover and flipped off the barrier, completing one-quarter turn (Event 4). It slid a short distance within the northbound lane before coming to rest within the roadway on its right plane, facing north (**Figure 5**). During the rollover, the rearward portion (foot end) of the stretcher disengaged from the locking clamp mechanism and the stretcher was partially displaced [right laterally].



**Figure 5:** View of the overturned ambulance at final rest (image obtained from a local news source).

Due to the partial separation of the battery compartment during the crash sequence, an electrical short circuit developed as a fragment of deformed metal bridged the battery terminals. Resulting sparks ignited a small post-crash fire (Event 5) that was fed by leaking battery fluids and surrounding polymer components.

### ***Post-Crash***

The local emergency response system received multiple cellular telephone calls reporting the crash. Local law enforcement, fire department, and emergency medical services personnel were dispatched to the scene. The first fire department apparatus arrived within minutes. Its personnel identified the small electrical fire that had developed and immediately extinguished it. Subsequent arriving personnel assisted the occupants out of the overturned ambulance. Ground ambulances transported all four occupants to a local hospital for evaluation and treatment of their injuries. They were all released from the hospital's emergency department on the same day.



## 2009 CHEVROLET C4500 / ROADRESCUE ULTRAMEDIC TYPE I AMBULANCE

### *Description*

The ambulance was a 2009 Chevrolet C4500 chassis manufactured in July 2009 and identified by the Vehicle Identification Number (VIN): 1GBE4C1979Fxxxxxx. The chassis was completed during secondary manufacturing in November 2009 with a Type I ambulance body. **Figure 6** depicts the Chevrolet ambulance on December 3, 2009, its delivery date to the ambulance agency. The chassis was a dual-rear wheel drive platform powered by a 6.6 liter, V-8 diesel engine linked to a 4-speed automatic transmission. It had a 447 cm (176 in) wheelbase.



**Figure 6:** Front left oblique view of the completed 2009 Chevrolet C4500 / RoadRescue Type I ambulance (image obtained from the manufacturer).

Secondary manufacturing of the vehicle consisted of the installation of the RoadRescue patient compartment module and installation of emergency services operational equipment (warning lights, sirens, and radio communications). Completed as a Type I Certified “Star of Life” ambulance, the vehicle was configured with a forward cab and a rear patient compartment equipped for the treatment of medical emergencies in a mobile environment. A placard confirmed that the RoadRescue Type I ambulance conformed to Federal Specifications KKK-A-1822 in effect on its date of manufacture. This refers to the United States General Services Administration’s (GSA) standard for minimum specifications, test parameters, and criteria for design, performance, equipment, and appearance of ambulances in order to display the six-pointed blue star with Rod of Asclepius (Star of Life).

The Chevrolet’s cab was configured for the seating of two occupants, with forward-facing box-mounted seats that featured manual seat track and seat back recline adjustments. Three-point lap and shoulder safety belt systems were available for manual restraint and head restraints were integrated into the seat backs. There were no available supplemental restraints. The cab’s seats were divided by a center storage console that integrated communications equipment and an array of switches related to the ambulance’s emergency response and operational activities. Within the patient compartment module was seating for up to five crewmembers as well as the patient. These included one position on the left plane, one position on the forward plane, a three-passenger bench seat on the right plane, and a centrally-located single occupant stretcher. Various configurations of manual restraint were available for all six positions.

The RoadRescue Ultramedic patient compartment module had overall dimensions length x width x height of 427 x 244 x 178 cm (168 x 96 x 70 in). There were eight exterior compartments (four on both side planes) and three occupant access doors (one right, two rear). The exterior compartments served for the storage of and curbside access to large emergency medical

equipment and supplies, such as backboards, stair-chairs, trauma dressing kits, splints, oxygen cylinders, and roadside safety/vehicle equipment. Doublewide rear doors served for the loading and unloading of the stretcher, as well as entry/exit for the crew. There was also an occupant access door at the forward aspect of the right side.

### ***Vehicle Weight, Payload, and Tire Data***

The Chevrolet chassis was placarded by its manufacturer with a Gross Vehicle Weight Rating (GVWR) of 7,484 kg (16,500 lb). This was distributed as Gross Axle Weight Ratings (GAWR) of 3,175 kg (7,000 lb) front and 4,989 kg (11,000 lb) rear. A vehicle weight/payload certification sticker was located on the interior surface of the forward most exterior compartment door, placarded by the manufacturer of the RoadRescue ambulance module. It declared that the curb weight of the overall vehicle after secondary manufacturing was 6,598 kg (14,545 lb). The curb weight at the axle locations was 2,828 kg (6,235 lb) front and 3,769 kg (8,310 lb) rear. At the ambulance's date of manufacture, the minimum available payload allowed by the KKK-A-1822 specifications was 1,021 kg (2,250 lb). According to the vehicle's placard, the calculated actual payload of the completed vehicle was 887 kg (1,955 lb). Based on experience and knowledge of EMS equipment and typical ambulance configuration, the estimated combined weight of the equipment and supplies on-board the ambulance at the time of the crash was a minimum of 431 kg (950 lb). According to interview information and medical records, the combined weight of the four occupants of the ambulance at the time of the crash was calculated to be approximately 329 kg (725 lb). Based on those calculations and the vehicle's placards, it was concluded that the laden ambulance was not operating in excess of its available payload capacity at the time of the crash.

The vehicle manufacturer's recommended tire size was 225/70R19.5, with recommended cold tire pressures of 660 kPa (96 PSI) front and 520 kPa (75 PSI) rear. At time of the SCI inspection, the vehicle was equipped with Goodyear G647 RSS tires of the manufacturer's recommended size at all six axle positions, mounted on OEM steel wheels. Specific tire data at the time of SCI inspection was as follows:

<b>Position</b>	<b>Tire Identification Number (TIN)</b>	<b>Measured Pressure</b>	<b>Measured Tread Depth</b>	<b>Restriction</b>	<b>Damage</b>
LF	MJ9Y XPBW 1209	Flat	9 mm (11/32 in)	N/A	None
LR inner	Unknown	552 kPa (80 PSI)	12 mm (15/32 in)	No	None
LR outer	MJ9Y DLBW 2808	545 kPa (79 PSI)	13 mm (16/32 in)	No	None
RR outer	MJ9Y DLBW 2908	483 kPa (70 PSI)	12 mm (15/32 in)	No	None
RR inner	Unknown	510 kPa (74 PSI)	12 mm (15/32 in)	No	None
RF	MJ9Y XPBW 1209	476 kPa (69 PSI)	11 mm (14/32 in)	N/A	None

### ***Exterior Damage***

Damage to the exterior of the ambulance from the multiple event crash was present on the front, right, and undercarriage planes of the vehicle. Direct contact damage associated with the Event 1 impact was located on the frontal plane and extending onto the right plane in a sideswiping fashion. On the frontal plane, damage began at the bumper corner and extended 10 cm (3.9 in) left laterally. Extension down the right plane measured 122 cm (48 in), beginning at the right front bumper corner and extending to the right front fender aft of the right front axle position (**Figure 7**). Within the damage pattern were body surface abrasions and minor deformation, with direct contact evident to the right front wheel and bumper corner. The Truck Deformation Classification (TDC) assigned to the ambulance for the Event 1 impact was 01FRLS5.



**Figure 7:** Event 1 damage on the right plane of the Chevrolet's cab.



**Figure 8:** Frontal plane damage to the Chevrolet ambulance associated with Events 2 and 3.

Frontal plane damage was attributed to the Events 2 and 3 impacts with the impact attenuators and concrete median barrier (**Figure 8**). Event 3 damage extended onto the undercarriage plane. Frontal plane damage associated with Event 2 was present across the entire 202 cm (79.5 in) frontal end width, with minor bumper deformation. Due to the non-fixed status of the impact attenuators and their purpose, in combination with the vehicle's size and mass, the Chevrolet did not sustain significant damage attributable to this event. Although the exact number of sand barrels impacted could not be determined, due to the distribution of the event impacts across the ambulance's frontal plane, the TDC assigned was 12FDEW1.

The concrete median barrier impact associated with Event 3 of the crash sequence was located at the left aspect of the Chevrolet's frontal plane. Frontal plane damage began 50 cm (19.7 in) left of center and extended to the left front bumper corner. This included longitudinal and vertical displacement of the front bumper beam, with significant extension onto the vehicle's undercarriage as the ambulance mounted the barrier. As the ambulance overrode the barrier, the left front axle engaged the barrier's leading edge and was sheared from the vehicle's chassis (**Figure 9**). The leading edge of the patient compartment module, at chassis level aft of the left front door of the cab, contacted and was deformed by the barrier (**Figure 10**).



**Figure 9:** Separated front axle of the Chevrolet ambulance, attributable to Event 3.



**Figure 10:** Damage associated with the Event 3 impact and engagement to the Chevrolet ambulance.

Exact extent of the damage sustained by the vehicle's undercarriage from the concrete median barrier resultant from the Chevrolet mounting and traversing along top of it remains unknown. This is primarily due to the lack of facilities and equipment necessary to raise the vehicle and inspect the undercarriage in its entirety.

Based on the trajectory and dynamics of the vehicle's crash sequence in conjunction with the circumstances of its rollover and the location at final rest, the Chevrolet's entire undercarriage likely contacted and engaged the barrier while the vehicle traversed on top of it for a distance of approximately 11 m (36 ft). In all, the Chevrolet ambulance traversed on top of three sections of the barrier. The TDC assigned to the vehicle for the frontal component of the Event 3 impact was 12FLLW2.

The Chevrolet's trajectory and positioning on top of the concrete barrier ultimately resulted in a right side-leading rollover sequence (Event 4). The rollover sequence's initiation was a flip-over type, and the ambulance completed one-quarter turn. Direct contact damage, consisting of minor body deformation and surface abrasions, was distributed across the ambulance's entire right plane. None of the right plane glazing sustained damage. The TDC assigned to the Chevrolet ambulance for the Event 4 rollover sequence was 00RDAO1. The ambulance's right plane is depicted in **Figure 11**.



**Figure 11:** Right plane view of the RoadRescue Ultramedic patient compartment module.

The right plane saddle compartment housing the vehicle's low-voltage (12-V) battery system, which consisted of three parallel-mounted batteries, was separated from the vehicle as a result of the rollover sequence.





**Figure 12:** Separated battery compartment and fire-damaged batteries of the Chevrolet ambulance.

One of the negative terminals of one of the batteries was pulled from the casement, which caused battery fluid leakage. This battery fluid coated the adjacent batteries. It was determined that a separated piece of steel fascia bridged the terminals of the compromised battery and an adjacent battery. This resulted in a series of sparks that ignited the leaking battery fluid, and the post-crash fire (Event 5) developed. Fire damage was limited to the separated battery packs and their compartment housing, with minimal extension of thermal discoloration and deformation to the fiberglass and polymer body panels beneath the right front door. The separated battery compartment and fire-damaged batteries are depicted in **Figure 12**.

### *Interior Damage*

The interior of the ambulance, including the Chevrolet chassis' cab and the patient compartment module, were inspected for crash-related and occupant contact damage. The interior of the Chevrolet chassis' cab sustained minor damage as a result of the crash. There was no intrusion associated with the exterior crash forces; however, the windshield glazing was fractured by impact forces during the crash sequence. Post-crash, the glazing separated and holed at its right aspect due to its fractured status and the plastic deformation of its bonding agent in the seasonal high temperatures.

Remaining damage within the cab's interior consisted of occupant contact to the right armrest of the left front seat and left lower instrument panel. Other notable findings within the cab included the frozen status of the instrument panel's gauge cluster (**Figure 13**). The speedometer was stuck at 37 km/h (23 mph), the tachometer was stuck at 1000 RPM, the fuel indicator level was stuck slightly below 1/2 of a tank, the oil pressure indicated 241 kPa (35 PSI), the temperature gauge read approximately 93 Celsius (200 Fahrenheit) degrees, and the batteries' voltage was stuck at 14-V.



**Figure 13:** Frozen instrument panel gauge cluster within the Chevrolet ambulance.

Minimal damage was sustained by the interior of the patient compartment module as a result of the crash. Due to the lateral forces associated with the rollover, all cabinetry latches on the left wall of the patient compartment released. This enabled all supplies and equipment within the cabinetry on the left wall of the patient compartment module to be spilled throughout its interior.

Slight deformation to the bulkhead wall was noted, the result of induced buckling associated with the shifting of the patient compartment module on the chassis mounts in response to the crash forces. Due to the dusty environment within the impound lot, and in conjunction with muddy footprints and scattered debris associated with post-crash egress, no occupant contact points within the patient compartment module could be identified.

### ***Manual Restraint Systems***

The cab of the Chevrolet chassis was equipped with manual restraint systems for both seating positions. Each was a 3-point lap and shoulder safety belt system that consisted of continuous loop webbing with a sliding latch plate, and was fixed at its respective B-pillar-mounted D-ring anchor position. The driver's safety belt retracted onto an Emergency Locking Retractor (ELR), while the front right passenger's safety belt retracted onto an ELR/Automatic Locking Retractor (ALR).

At the time of the SCI inspection, both belt systems were intact, operational, and exhibited evidence of historical use. They were both loosely retracted against their respective B-pillars. No significant loading evidence was present on the driver's safety belt webbing; however, this is not decisively indicative of a lack of use due to the long duration and minor magnitude of the longitudinal deceleration associated with the crash forces.

The interior of the patient compartment module of the RoadRescue ambulance was equipped with manual safety belt systems at all five seating positions. All manual restraint systems within the patient compartment utilized continuous loop webbing. The lap belts for the CPR seat and bench seat retracted onto ELRs mounted to the patient compartment wall. These belt systems displayed minor to no evidence of historical use. The Captain's Chair was equipped with an integrated 3-point lap and shoulder safety belt system with box-mounted ELR, which also displayed no obvious evidence of historical use. Evidence on the patient compartment module's restraint systems could not confirm occupant use based solely on their post-crash conditions.

### ***Patient Stretcher***

The patient stretcher was a Performance Pro-XT Ambulance Cot that was manufactured by Stryker, serial number (S/N): 100141286. Based on this serial number, it was manufactured in January of 2010 and was constructed of a tubular aluminum frame with circumferential weld joints and steel hardware fasteners. The X-frame supporting the mattress platform featured manual raise/lower capabilities and the mattress platform featured 0-73 degrees of positive backrest angular adjustment via a manually controlled gas-pressure cylinder. In a similar fashion, the leg portion featured 15 degrees of positive angular adjustment. Overall dimensions of the stretcher were 58 cm (23 in) wide and 203 cm (80 in) long. A placard declared that the load capacity limit of the stretcher was a maximum of 318 kg (700 lb).

The Stryker stretcher (**Figure 14**) was equipped with a multi-point harness system for manual restraint of its occupant (patient). This multi-point harness system included a lateral leg strap, lateral lap strap, and shoulder/chest harness, in which a pair of shoulder straps buckled into a lateral chest strap. The safety belt webbing was continuous loop, and all straps included locking latch plates for length adjustment. Exact adjusted length of the straps at the time of the crash is unknown; however, ambulance agency policy requires that all patients must be securely restrained at all times by all straps when positioned on the stretcher. Although heavy historical use masked loading evidence, the post crash positioning of the patient and the post-crash observations of emergency services personnel confirmed complete restraint usage.



**Figure 14:** Stryker Performance PRO-XT stretcher within the Chevrolet.

The stretcher was secured in place within the patient compartment module via a Model 6370 Cot Fastener System. It was manufactured by Stryker in July of 2009, as identified by the manufacturer's S/N: 090739710. The system consisted of a forward antler bracket and rearward locking-clamp mechanism. The antler bracket cradled the forward portion (location of the patient's head area) of the stretcher's frame, while the vertically-oriented locking mechanism clamped around a pin protruding from the stretcher's lower frame rail. Combined, these two components restricted the lateral and longitudinal movement of the stretcher.

During the crash sequence, lateral forces associated with the rollover exceeded the locking clamp mechanism's load strength and the clamp released. This allowed the rearward portion (foot end) of the stretcher to move unrestricted. However, due to the short duration and low magnitude of the rollover and its forces, the stretcher was not fully displaced. The right aspect of the forward portion (head end) of the stretcher remained engaged within the antler bracket. As such, the stretcher simply pivoted until the rear aspect (foot end) contacted the base of the bench seat. No apparent damage was sustained by the stretcher or its fastener system as a result of the multiple event crash sequence, despite the apparent release of the stretcher's locking pin from the locking clamp. The antler bracket cradled the forward guide wheels, despite the overturned status of the ambulance.

**2009 CHEVROLET C4500 / ROADRESCUE TYPE I AMBULANCE OCCUPANTS*****Driver Demographics***

Age / Sex: 71 years / Male  
 Height: 180 cm (71 in)  
 Weight: 68 kg (150 lb)  
 Eyewear: None  
 Seat Type: Box-mounted seat (i.e. van type)  
 Seat Track Position: Seat between middle and rear most track positions  
 Manual Restraint Usage: 3-point lap and shoulder safety belt  
 Usage Source: Vehicle Inspection; Interview  
 Air Bags: None available  
 Alcohol/Drug Data: None  
 Egress from Vehicle: Exited vehicle under own power  
 Transport from Scene: Ground ambulance to a local hospital  
 Medical Treatment: Evaluated and released in less than 24 hours

***Driver Injuries***

Inj No.	Injury	AIS 2005/08	Injury Source	Confidence Level
N/A	Injuries not sustained during crash sequence	N/A	Post-crash egress	N/A

*Source: Emergency Department Records; Interview (Other: other occupant)*

***Driver Kinematics***

The 71-year-old male driver was seated in the box-mounted driver's seat with the seat track adjusted to a position between middle and full-rear. He utilized the available 3-point lap and shoulder safety belt for manual restraint, confirmed through the SCI vehicle inspection and interviews.

The restrained driver initiated a slight forward trajectory in response to the minor longitudinal forces associated with the Event 1 impact. Forces associated with the driver's pre-crash braking input had engaged the locking mechanism of the safety belt's retractor [ELR] and the driver loaded the safety belt. He remained restrained as the vehicle progressed through the crash sequence. Further loading was induced by the driver during the Event 2 impact sequence with the traffic attenuators and concrete barrier. As the ambulance mounted the barrier and initiated the Event 3 rollover, the driver initiated a right lateral trajectory. He remained within his seating position and loaded the safety belt webbing. This repetitive loading was evidenced by impressions on the polymer latch plate and as the ambulance came to final rest, the driver became suspended from the safety belt webbing in the driver's seat of the overturned vehicle.

The driver did not sustain injuries attributable to his kinematics during the crash sequence. This was primarily due to his restrained status. He did sustain a right arm abrasion and a right arm contusion, though both were attributed to his egress from the overturned vehicle post-crash. The driver was transported by a ground ambulance to a local hospital, where he was evaluated and released from its emergency department on the same day.



***Captain's Chair Occupant Demographics***

Age / Sex: 41 years / Female  
 Height: 147 cm (58 in)  
 Weight: 48 kg (106 lb)  
 Eyewear: None  
 Seat Type: Rear-facing, pedestal-mounted seat  
 Seat Track Position: Seat at middle track position  
 Manual Restraint Usage: None  
 Usage Source: Interview  
 Air Bags: None available  
 Alcohol/Drug Data: None  
 Egress from Vehicle: Exited vehicle with assistance  
 Transport from Scene: Ground ambulance to a local hospital  
 Medical Treatment: Evaluated and released in less than 24 hours

***Captain's Chair Occupant Injuries***

Inj No.	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Closed head injury, NFS	100099.9,9	Right occupant access door	Probable
2	Neck strain, NFS	640278.1,6	Right occupant access door	Probable

*Source: Emergency Department Records; Interview (Other: other occupant)*

***Captain's Chair Occupant Kinematics***

The 41-year-old female Emergency Medical Technician (EMT) was seated in the rear-facing Captain's Chair at the forward aspect of the patient compartment module. She did not utilize the available 3-point lap and shoulder safety belt for manual restraint. Due to her small stature, she sat in a forward position (with respect to her rear-facing orientation) as she spoke with the other occupants and assisted with patient care.

The Captain's Chair occupant initiated a rearward trajectory (with respect to her rear-facing orientation) in response to the longitudinal Event 1 crash forces. Her back and head contacted and loaded the seat back of the Captain's Chair, distributing associated forces. She maintained position in the seat as the vehicle progressed through the crash sequence and mounted the concrete barrier. These kinematics probably did not result in injury.

As the ambulance initiated its right side-leading rollover sequence (Event 3), the female captain's chair occupant initiated a left lateral trajectory. Her body separated from the seat, and her head subsequently contacted the interior aspect of the right occupant access door. This contact probably resulted in the closed head injury, with indirect neck strain. As the vehicle came to final rest, the female remained within the area of the right occupant access door. She complained of the head and neck injuries, as well as right hip pain, and was transported to a local hospital by a ground ambulance. The Captain's Chair occupant was released from the hospital on the same day.

***CPR Seat Occupant Demographics***

Age / Sex: 44 years / Male  
 Height: Unknown  
 Weight: Unknown  
 Eyewear: None  
 Seat Type: Right-facing, cabinet-mounted seat  
 Seat Track Position: Not adjustable  
 Manual Restraint Usage: None  
 Usage Source: Interview  
 Air Bags: None available  
 Alcohol/Drug Data: None  
 Egress from Vehicle: Exited vehicle under own power  
 Transport from Scene: Ground ambulance to a local hospital  
 Medical Treatment: Evaluated and released in less than 24 hours

***CPR Seat Occupant Injuries***

Inj No.	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Forehead abrasion	110202.1,5	Patient compartment ceiling	Probable
2	Left thigh contusion	810402.1,2	Left wall cabinetry adjacent to CPR seat	Probable

*Source: Emergency Department Records; Interview (same person)*

***CPR Seat Occupant Kinematics***

The 44-year-old male EMT was seated in the right-facing CPR seat on the left plane of the patient compartment. He did not utilize the available lap belt for manual restraint, as he was engaged in assisting with patient care. During the SCI interview, the male reported that he may have been partially standing while performing EMS treatments on the patient prior to the crash. This consisted of bandaging an abrasion on the patient using gauze.

The male EMT initiated a left lateral trajectory (with respect to his right facing orientation) in response to the longitudinal forces associated with the first two crash events. His left leg contacted and loaded the cabinetry mounted to the left wall of the patient compartment, adjacent to the CPR seat. This contact resulted in a contusion to his left thigh. He remained within the area of the CPR seat as the ambulance mounted the concrete barrier.

Forces associated with the rollover sequence then initiated a forward trajectory to the male EMT, directing him over the stretcher toward the right plane of the patient compartment. During this sequence, his head contacted the ceiling of the ambulance, resulting in the forehead abrasion. The male EMT came to rest lying on the right plane of the patient compartment as the overturned ambulance achieved final rest. A ground ambulance transported him to a local hospital, where he received treatment and was released from the emergency department on the same day.

***Stretcher Occupant Demographics***

Age / Sex: Unknown / Female  
 Height: Unknown  
 Weight: Unknown  
 Eyewear: Unknown  
 Seat Type: Immobilized in a supine position on long spine backboard positioned longitudinally on the stretcher  
 Seat Track Position: N/A  
 Manual Restraint Usage: Secured to the long spine backboard by a multi-point harness system; backboard restrained to stretcher using multiple lateral restraint straps  
 Usage Source: Interview (*Other occupants*)  
 Air Bags: None available  
 Alcohol/Drug Data: None  
 Egress from Vehicle: Removed from vehicle due to immobilization (pre-crash) on long spine backboard  
 Transport from Scene: Ground ambulance to a local hospital  
 Medical Treatment: Evaluated and released from the emergency department in less than 24 hours

***Stretcher Occupant Injuries***

Inj No.	Injury	AIS 2005/08	Injury Source	Confidence Level
N/A	Unknown	N/A	N/A	N/A

*Source: Medical records requested, but not received*

***Stretcher Occupant Kinematics***

Prior to the subject crash, the unknown-aged female patient had been involved in a separate vehicle crash. Pursuant to that crash, the subject ambulance had responded to the scene and its 3-member crew provided EMS care. This resulted in the immobilization of the female in a supine position on a long spine backboard and restrained to the board using a multi-point harness system. The backboard itself was secured to the stretcher using the stretcher's available lateral restraint straps. This restraint usage was reported to the SCI Investigator during interviews with the EMS crew and on-scene personnel.

Due to the patient's immobilization and restraint status in conjunction with the minor severity magnitude of the associated crash forces, she remained in her initial supine position on the long spine board and on the stretcher throughout the entire crash sequence. However, the lateral crash forces associated with the rollover exceeded the locking clamp mechanism's load strength and the clamp released. The right aspect of the forward portion (head end) of the stretcher remained engaged within the antler bracket as the rear aspect (foot end) was displaced laterally until it contacted the base of the bench seat. This displacement did not result in injury to the occupant.

As the vehicle came to final rest, the patient remained secured to the long spine backboard (which remained restrained to the stretcher). Due to the release of the locking clamp mechanism and corresponding partial displacement of the stretcher, removal of the patient from the stretcher required the removal of the stretcher from the overturned vehicle. On-scene emergency services personnel removed the stretcher from the overturned ambulance, then transferred the patient (still immobilized on the long spine backboard) to the stretcher of another awaiting ground ambulance. She was transported to a local hospital to receive treatment of her injuries sustained in the initial crash in which she was involved that had precipitated her immobilization on the long spine board, as well as evaluation for potential injuries sustained in the subject crash. The female patient was released from the emergency department within 24 hours. She declined interview, and the extent of her injuries, as well as their distribution between the initial and subject crashes, remains unknown.

## 2012 FORD FUSION

### *Description*

The 2012 Ford Fusion (**Figure 15**) was a white sedan identified by the VIN: 3FAHP0JA7CRxxxxxx. It was powered by a 2.5 liter, 4-cylinder gasoline engine. The Ford had a 273 cm (107.5 in) wheelbase and a reported curb weight of 1,650 kg (3,638 lb). It was configured for the seating of five passengers, and was equipped with 3-point manual lap and shoulder belts for all seating positions.



**Figure 15:** Left front oblique view of the 2012 Ford Fusion.



**Figure 16:** Left plane view of the Event 1 damage sustained by the Ford.

### *Damage*

Damage attributed to Event 1 of the crash was located on the left plane, primarily in the area of the left front door (**Figure 16**). Direct contact damage measured 351 cm (138.2 in) in length and was distributed along the left front door, left A-pillar, left front fender, left B-pillar, left rear door, and left rear fender. This included minor body deformation with surface abrasions, and related crash forces has resulted in the deployment of the Ford's left Inflatable Curtain (IC) and left front seat back-mounted side impact air bags.

The direct and induced damage (Field-L) began 26 cm (10.2 in) forward of the left front axle and extended 391 cm (153.9 in) rearward. A residual crush profile documented at mid-bumper level produced the following results: C1 = 0 cm (0 in), C2 = 0 cm (0 in), C3 = 1 cm (0.5 in), C4 = 1 cm (0.5 in), C5 = 14 cm (5.5 in), and C6 = 0 cm (0 in). Maximum crush measured 15 cm (5.9 in). The Collision Deformation Classification (CDC) assigned to the Ford for the Event 1 impact was 07LDAW2.

### ***Event Data Recorder***

The 2012 Ford Fusion was equipped with a Restraints Control Module (RCM) mounted within the center tunnel that had EDR capabilities. The RCM had EDR capabilities to record and store up to two events. Data was imaged from the Ford's RCM during the inspection process, using the Bosh Crash Data Retrieval (CDR) tool and software version 5.0.2 via the Diagnostic Link Connector (DLC) with external power supplied through the vehicle's fuse block. It was later analyzed using software version 10.0, and is included at the end of this technical report as **Attachment A**.

The EDR data imaged from the Ford had two stored events, termed "locked side event" and "unlocked event", which were related to Event 1 of the subject crash. Both occurred on the ignition counter number of 1,591, with an EDR reported "complete event recording". There was a 5-second pre-crash buffer associated with each event that recorded Vehicle Speed, Accelerator Pedal Position, Brake Status, and Engine Speed (RPM) data. It also monitored and recorded anti-lock brake, stability control, and traction control activity for the same time intervals. The two recorded events shared the same recorded pre-crash buffer data, as follows:

<b>Time (Seconds)</b>	<b>Vehicle Speed</b>	<b>Accelerator Pedal Position</b>	<b>Brake Status</b>	<b>Engine (RPM)</b>
-5.0	29 km/h (18 mph)	0%	ON	1,100
-4.5	27 km/h (16.8 mph)	0%	OFF	1,000
-4.0	26 km/h (16.2 mph)	10%	OFF	900
-3.5	25 km/h (15.5 mph)	13%	OFF	1,300
-3.0	26 km/h (16.2 mph)	14%	OFF	1,500
-2.5	26 km/h (16.2 mph)	0%	OFF	1,400
-2.0	25 km/h (15.5 mph)	0%	OFF	1,200
-1.5	25 km/h (15.5 mph)	3%	OFF	1,300
-1.0	25 km/h (15.5 mph)	24%	OFF	1,500
-0.5	27 km/h (16.8 mph)	38%	OFF	2,000
0.0	28 km/h (17.4 mph)	34%	OFF	1,700

For all pre-crash time intervals, the anti-lock brake, stability control, and traction control activity all remained "non-engaged." However, the traction control via braking system became engaged at time zero. Pre-crash data for the steering wheel angle and stability control (lateral acceleration, longitudinal acceleration, and yaw rate) remained within a range consistent with a controlled, sweeping right-turn travel path for all pre-crash time intervals prior to AE.

Data for the “locked side event” reported that the driver belt status was “Buckled” with a respective seat track position “Not forward.” The following sequence of deployments for the equipped air bag and pretensioner systems were reported:

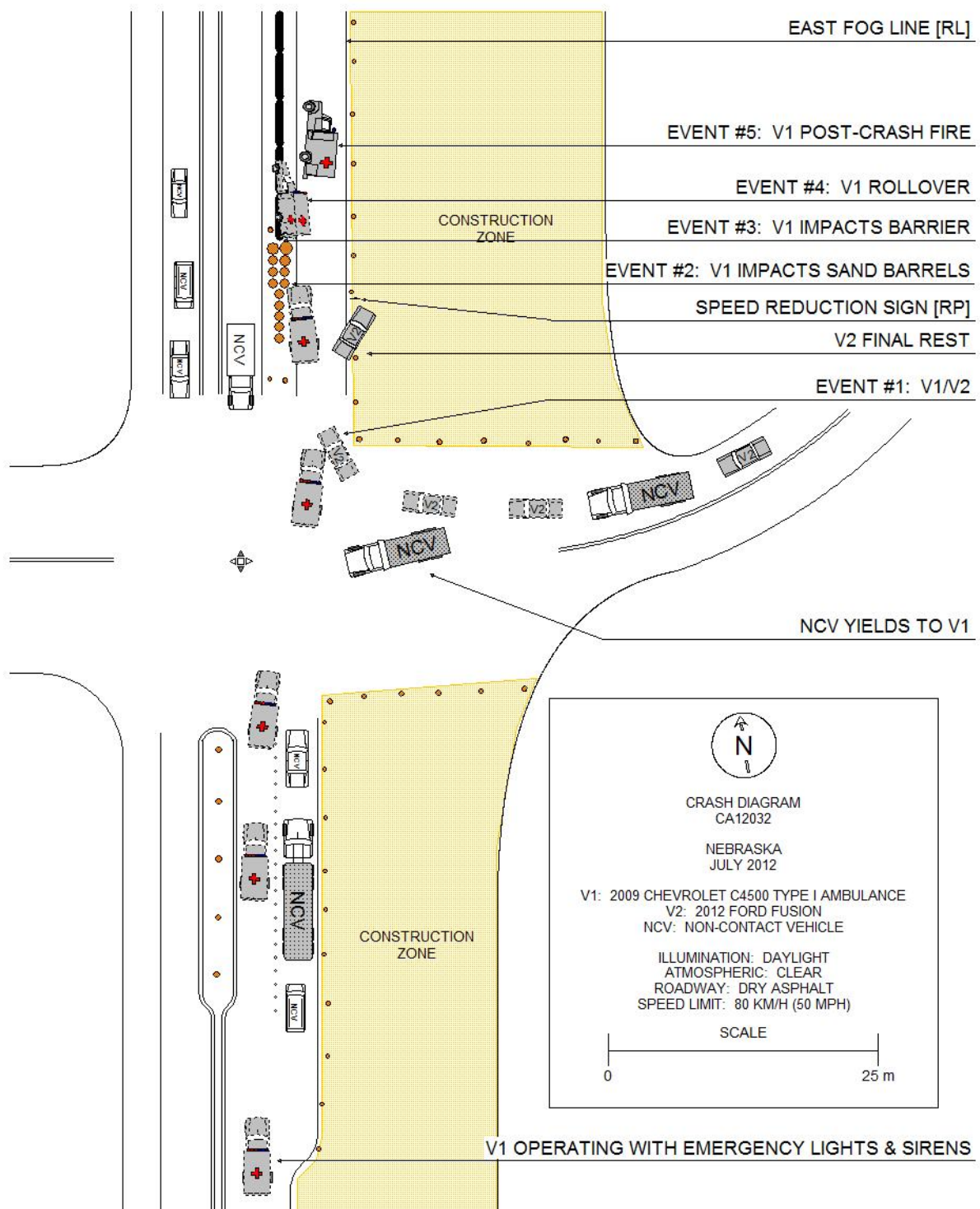
<b>Restraint System</b>	<b>Post-AE Time Interval (milliseconds)</b>
Retractor pretensioner deployment (driver)	16.5
Side (thorax) air bag deployment (driver)	16.5
Side curtain air bag deployment (driver)	16.5

The maximum RCM recorded longitudinal delta-V associated with the “locked side event” was 10.89 km/h (6.77 mph) and occurred at 168.5 milliseconds after AE. Similarly, the maximum recorded lateral delta-V of the “locked side event” was 18.03 km/h (11.2 mph) and occurred at 208.5 milliseconds after AE. The longitudinal and lateral delta-Vs of the “unlocked event” were both -2.37 km/h (-1.47 mph) and occurred at 252.5 and 112.5 milliseconds after AE, respectively.

#### ***Occupant Data***

A 56-year-old male driver occupied the Ford at the time of the crash. According to the Police Crash Report (PAR), he did not sustain injuries as a result of the crash. The driver refused medical treatment and transport at the scene.

## CRASH DIAGRAM



**ATTACHMENT A:**

2012 Ford Fusion Event Data Recorder (EDR) Report



IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

## CDR File Information

User Entered VIN	3FAHP0JA7CR*****
User	
Case Number	
EDR Data Imaging Date	07/17/2012
Crash Date	
Filename	CA12032_V2_RCM.CDRX
Saved on	Tuesday, July 17 2012 at 10:23:21
Collected with CDR version	Crash Data Retrieval Tool 5.0.2
Reported with CDR version	Crash Data Retrieval Tool 10.0
EDR Device Type	Airbag Control Module
ACM Adapter Detected During Download	Yes
Event(s) recovered	locked side event unlocked event

## Comments

No comments entered.

The retrieval of this data has been authorized by the vehicle's owner, or other legal authority such as a court order or search warrant, as indicated by the CDR tool user on Tuesday, July 17 2012 at 10:23:21.

## Data Limitations

### Restraints Control Module Recorded Crash Events:

Deployment Events cannot be overwritten or cleared from the Restraints Control Module (RCM). Once the RCM has deployed any airbag device, the RCM must be replaced. The data from events which did not qualify as deployable events can be overwritten by subsequent events. The RCM can store up to two deployment events.

### Airbag Module Data Limitations:

- Restraints Control Module Recorded Vehicle Forward Velocity Change reflects the change in forward velocity that the sensing system experienced from the point of algorithm wake up. It is not the speed the vehicle was traveling before the event. Note that the vehicle speed is recorded separately five seconds prior to algorithm wake up. This data should be examined in conjunction with other available physical evidence from the vehicle and scene when assessing occupant or vehicle forward velocity change.
- Event Recording Complete will indicate if data from the recorded event has been fully written to the RCM memory or if it has been interrupted and not fully written.
- If power to the Airbag Module is lost during a crash event, all or part of the crash record may not be recorded.
- For 2011 Ford Mustangs, the Steering Wheel Angle parameter indicates the change in steering wheel angle from the previously recorded sample value and does not represent the actual steering wheel position.

### Airbag Module Data Sources:

- Event recorded data are collected either INTERNALLY or EXTERNALLY to the RCM.
  - INTERNAL DATA is measured, calculated, and stored internally, sensors external to the RCM include the following:
    - > The Driver and Passenger Belt Switch Circuits are wired directly to the RCM.
    - > The Driver's Seat Track Position Switch Circuit is wired directly to the RCM.
    - > The Side Impact Sensors (if equipped) are located on the side of vehicle and are wired directly to the RCM.
    - > The Occupant Classification Sensor is located in the front passenger seat and transmits data directly to the RCM on high-speed CAN bus.
    - > Front Impact Sensors (right and left) are located at the front of vehicle and are wire directly to the RCM.
  - EXTERNAL DATA recorded by the RCM are data collected from the vehicle communication network from various sources such as Powertrain Control Module, Brake Module, etc.

02007\_RCM-RC6\_r002

**System Status at Time of Retrieval**

VIN as programmed into RCM at factory	3FAHP0JA7CR*****
Current VIN from PCM	3FAHP0JA7CR*****
Ignition cycle, download (first record)	1,592
Ignition cycle, download (second record)	1,592
Restraints Control Module Part Number	BE53-14B321-BD
Restraints Control Module Serial Number	3021185100000000
Restraints Control Module Software Part Number (Version)	BL84-14C028-AB
Left/Center Frontal Restraints Sensor Serial Number	146B7EAD
Left Side Restraint Sensor 1 Serial Number	A8513C02
Left Side Restraint Sensor 2 Serial Number	146C077C
Right Frontal Restraints Sensor Serial Number	146B21B5
Right Side Restraint Sensor 1 Serial Number	00605902
Right Side Restraints Sensor 2 Serial Number	146A46C2

**System Status at Event (First Record)**

Recording Status	Locked Record
Complete file recorded (yes,no)	Yes
Multi-event, number of events (1,2)	1
Time from event 1 to 2 (msec)	N/A
Lifetime Operating Timer at event time zero (seconds)	2,017,830
Key-on Timer at event time zero (seconds)	435
Vehicle voltage at time zero (Volts)	13.365
Energy Reserve Mode entered during event (Y/N)	No

**Faults Present at Start of Event (First Record)**

No Faults Recorded
--------------------

**Deployment Data (First Record)**

Side curtain airbag deployment, time to deploy, driver side (msec)	16.5
Side (thorax) air bag deployment, time to deploy, driver (msec)	16.5
Pretensioner (retractor) deployment, time to fire, driver (msec)	16.5
Maximum delta-V, longitudinal (MPH [km/h])	6.78 [10.91]
Time, maximum delta-V longitudinal (msec)	170
Maximum delta-V, lateral (MPH [km/h])	11.24 [18.09]
Time, maximum delta-V lateral (msec)	212
Left, forward, side satellite sensor discriminating deployment	Yes
Left, forward, side satellite sensor safing	Yes
RCM, side left sensor safing	Yes
RCM, side right sensor safing	Yes
Longitudinal Delta-V Time Zero Offset	8.5 ms
Lateral Delta-V Time Zero Offset	8.5 ms

**Pre-Crash Data -1 sec (First Record)**

Ignition cycle, crash	1,591
Frontal air bag warning lamp, on/off	Off
Occupant size classification, front passenger (Child size Yes/No [Hex value])	No [\$01]
Safety belt status, driver	Driver Buckled
Seat track position switch, foremost, status, driver	Not Forward
Safety belt status, front passenger	Passenger Not Buckled
Brake Telltale	Off
ABS Telltale	Off
Stability Control Telltale	Off
Speed Control Telltale	Off
Powertrain Wrench Telltale	Off
Powertrain Malfunction Indicator Lamp (MIL) Telltale	Off

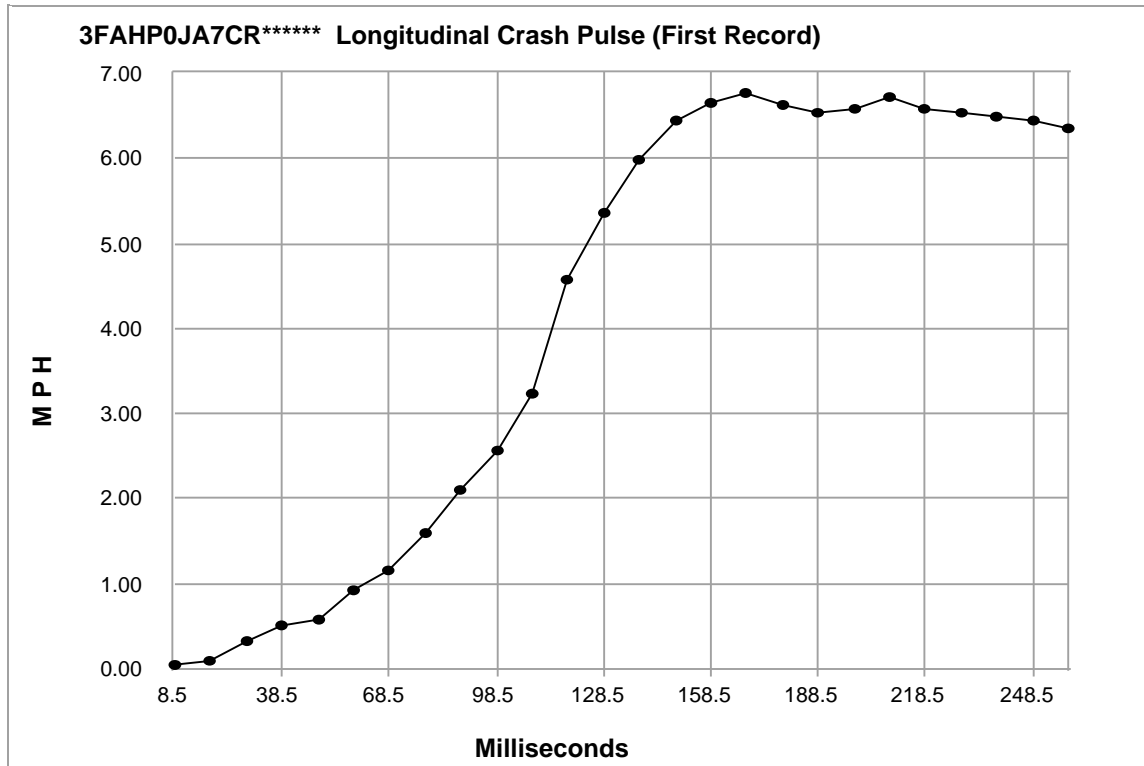
**Pre-Crash Data -5 to 0 sec [2 samples/sec] (First Record)**

<b>Times (sec)</b>	<b>Speed vehicle indicated MPH [km/h]</b>	<b>Accelerator pedal, % full</b>	<b>Service brake, on/off</b>	<b>Engine RPM</b>	<b>ABS activity (engaged, non-engaged)</b>	<b>Stability control (engaged, non-engaged)</b>	<b>Traction Control via Brakes (engaged, non-engaged)</b>	<b>Traction Control via Engine (engaged, non-engaged)</b>
- 5.0	18.0 [29.0]	0	On	1,100	non-engaged	non-engaged	non-engaged	non-engaged
- 4.5	16.8 [27.0]	0	Off	1,000	non-engaged	non-engaged	non-engaged	non-engaged
- 4.0	16.2 [26.0]	10	Off	900	non-engaged	non-engaged	non-engaged	non-engaged
- 3.5	15.5 [25.0]	13	Off	1,300	non-engaged	non-engaged	non-engaged	non-engaged
- 3.0	16.2 [26.0]	14	Off	1,500	non-engaged	non-engaged	non-engaged	non-engaged
- 2.5	16.2 [26.0]	0	Off	1,400	non-engaged	non-engaged	non-engaged	non-engaged
- 2.0	15.5 [25.0]	0	Off	1,200	non-engaged	non-engaged	non-engaged	non-engaged
- 1.5	15.5 [25.0]	3	Off	1,300	non-engaged	non-engaged	non-engaged	non-engaged
- 1.0	15.5 [25.0]	24	Off	1,500	non-engaged	non-engaged	non-engaged	non-engaged
- 0.5	16.8 [27.0]	38	Off	2,000	non-engaged	non-engaged	non-engaged	non-engaged
0.0	17.4 [28.0]	34	Off	1,700	non-engaged	non-engaged	engaged	non-engaged

**Pre-Crash Data -5 to 0 sec [10 samples/sec] (First Record)**

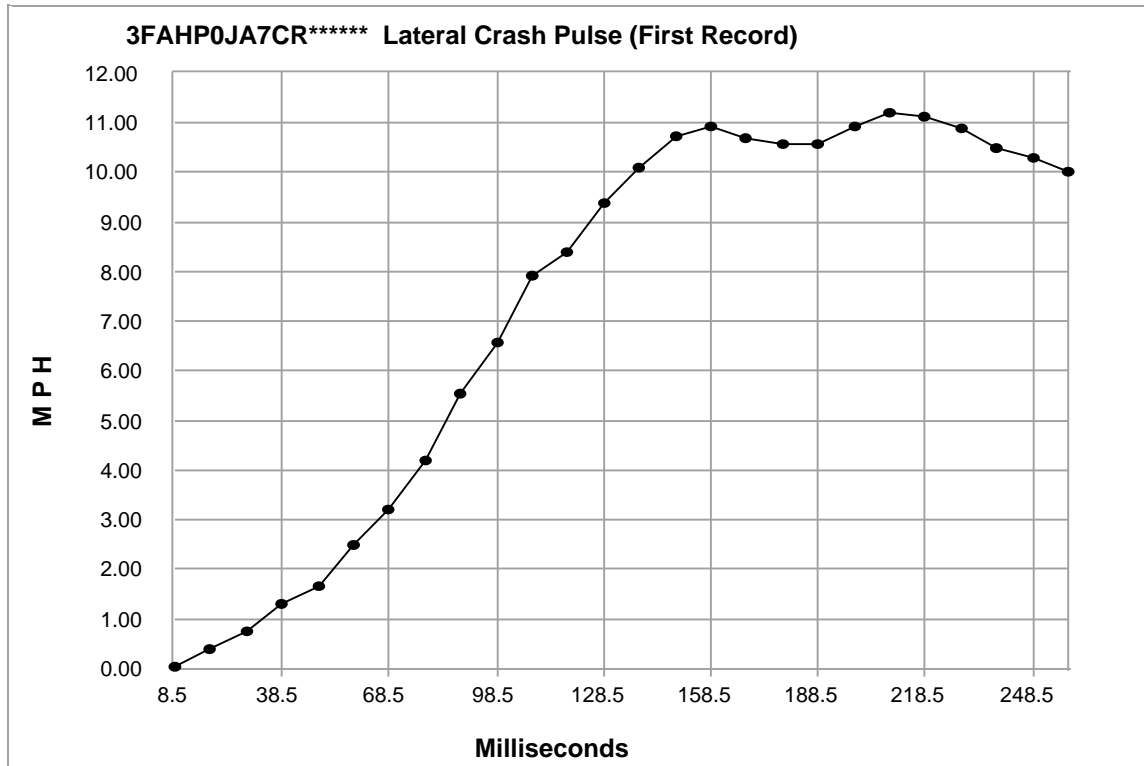
Times (sec)	Steering Wheel Angle (degrees)	Stability Control Lateral Acceleration (g)	Stability Control Longitudinal Acceleration (g)	Stability Control Yaw Rate (deg/sec)
- 5.0	-73.7	-0.142	-0.086	-11.62
- 4.9	-69.1	-0.131	-0.015	-10.87
- 4.8	-68.8	-0.221	-0.007	-10.0
- 4.7	-70.0	-0.201	-0.025	-10.0
- 4.6	-71.5	-0.192	-0.024	-10.12
- 4.5	-75.6	-0.212	-0.057	-9.87
- 4.4	-81.5	-0.209	-0.035	-10.62
- 4.3	-84.3	-0.201	-0.027	-11.87
- 4.2	-89.5	-0.218	-0.056	-11.62
- 4.1	-96.0	-0.245	-0.063	-11.87
- 4.0	-103.8	-0.301	-0.029	-13.5
- 3.9	-108.2	-0.295	-0.047	-14.37
- 3.8	-108.9	-0.236	-0.043	-15.62
- 3.7	-108.5	-0.258	-0.07	-15.25
- 3.6	-106.0	-0.228	-0.016	-15.0
- 3.5	-100.1	-0.241	0.08	-14.62
- 3.4	-90.9	-0.251	0.004	-13.87
- 3.3	-84.0	-0.212	0.012	-12.25
- 3.2	-79.1	-0.152	0.019	-11.37
- 3.1	-77.9	-0.134	0.007	-10.62
- 3.0	-84.3	-0.174	0.039	-10.87
- 2.9	-93.3	-0.259	0.004	-12.0
- 2.8	-99.5	-0.278	0.017	-13.25
- 2.7	-104.6	-0.261	0.002	-14.37
- 2.6	-106.9	-0.322	-0.008	-15.0
- 2.5	-106.0	-0.291	-0.026	-15.0
- 2.4	-105.6	-0.227	-0.017	-15.37
- 2.3	-106.1	-0.219	-0.026	-14.25
- 2.2	-108.5	-0.288	-0.058	-13.75
- 2.1	-113.3	-0.142	-0.064	-14.62
- 2.0	-114.2	-0.302	-0.036	-16.37
- 1.9	-110.1	-0.177	-0.108	-15.5
- 1.8	-107.0	-0.224	-0.064	-14.62
- 1.7	-107.9	-0.27	0.057	-14.75
- 1.6	-110.9	-0.291	0.039	-13.87
- 1.5	-118.9	-0.261	0.017	-16.0
- 1.4	-134.3	-0.343	-0.073	-16.37
- 1.3	-144.8	-0.365	-0.005	-19.0
- 1.2	-148.6	-0.344	0.014	-20.87
- 1.1	-150.8	-0.418	0.003	-20.25
- 1.0	-161.4	-0.369	0.081	-20.75
- 0.9	-175.2	-0.481	0.079	-23.12
- 0.8	-191.1	-0.559	0.105	-24.62
- 0.7	-209.6	-0.428	-0.028	-28.5
- 0.6	-221.8	-0.509	-0.068	-29.37
- 0.5	-226.2	-0.469	-0.029	-28.5
- 0.4	-227.6	-0.572	0.094	-30.37
- 0.3	-225.6	-0.551	0.042	-34.25
- 0.2	-225.0	-0.507	-0.029	-37.62
- 0.1	-220.7	-0.571	-0.015	-37.87
0.0	-202.7	-0.49	0.033	-36.12





**Longitudinal Crash Pulse (First Record)**

Time (msec)	Delta-V, longitudinal (MPH)	Delta-V, longitudinal (km/h)
8.5	0.03	0.06
18.5	0.09	0.14
28.5	0.32	0.51
38.5	0.51	0.82
48.5	0.58	0.93
58.5	0.92	1.48
68.5	1.16	1.86
78.5	1.60	2.57
88.5	2.09	3.37
98.5	2.57	4.14
108.5	3.23	5.20
118.5	4.58	7.38
128.5	5.37	8.64
138.5	5.97	9.61
148.5	6.45	10.37
158.5	6.65	10.70
168.5	6.77	10.89
178.5	6.63	10.66
188.5	6.54	10.52
198.5	6.60	10.61
208.5	6.71	10.81
218.5	6.59	10.60
228.5	6.53	10.51
238.5	6.49	10.44
248.5	6.44	10.36
258.5	6.35	10.23



**Lateral Crash Pulse (First Record)**

Time (msec)	Delta-V, lateral (MPH)	Delta-V, lateral (km/h)
8.5	0.06	0.09
18.5	0.40	0.64
28.5	0.74	1.19
38.5	1.32	2.12
48.5	1.68	2.71
58.5	2.49	4.00
68.5	3.20	5.16
78.5	4.18	6.73
88.5	5.53	8.90
98.5	6.56	10.56
108.5	7.90	12.72
118.5	8.41	13.54
128.5	9.38	15.09
138.5	10.10	16.25
148.5	10.72	17.26
158.5	10.93	17.58
168.5	10.70	17.22
178.5	10.59	17.04
188.5	10.56	17.00
198.5	10.92	17.57
208.5	11.20	18.03
218.5	11.14	17.93
228.5	10.90	17.55
238.5	10.51	16.92
248.5	10.30	16.58
258.5	10.01	16.11

**System Status at Event (Second Record)**

Recording Status	Unlocked Record
Complete file recorded (yes,no)	Yes
Multi-event, number of events (1,2)	2
Time from event 1 to 2 (msec)	100
Lifetime Operating Timer at event time zero (seconds)	2,017,830
Key-on Timer at event time zero (seconds)	435
Vehicle voltage at time zero (Volts)	13.203
Energy Reserve Mode entered during event (Y/N)	No

**Faults Present at Start of Event (Second Record)**

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**Deployment Data (Second Record)**

Maximum delta-V, longitudinal (MPH [km/h])	-1.85 [-2.98]
Time, maximum delta-V longitudinal (msec)	300
Maximum delta-V, lateral (MPH [km/h])	-1.48 [-2.38]
Time, maximum delta-V lateral (msec)	300
Longitudinal Delta-V Time Zero Offset	2.5 ms
Lateral Delta-V Time Zero Offset	2.5 ms

**Pre-Crash Data -1 sec (Second Record)**

Ignition cycle, crash	1,591
Frontal air bag warning lamp, on/off	On
Occupant size classification, front passenger (Child size Yes/No [Hex value])	No [\$01]
Safety belt status, driver	Driver Buckled
Seat track position switch, foremost, status, driver	Not Forward
Safety belt status, front passenger	Passenger Not Buckled
Brake Telltale	Off
ABS Telltale	Off
Stability Control Telltale	Off
Speed Control Telltale	Off
Powertrain Wrench Telltale	Off
Powertrain Malfunction Indicator Lamp (MIL) Telltale	Off

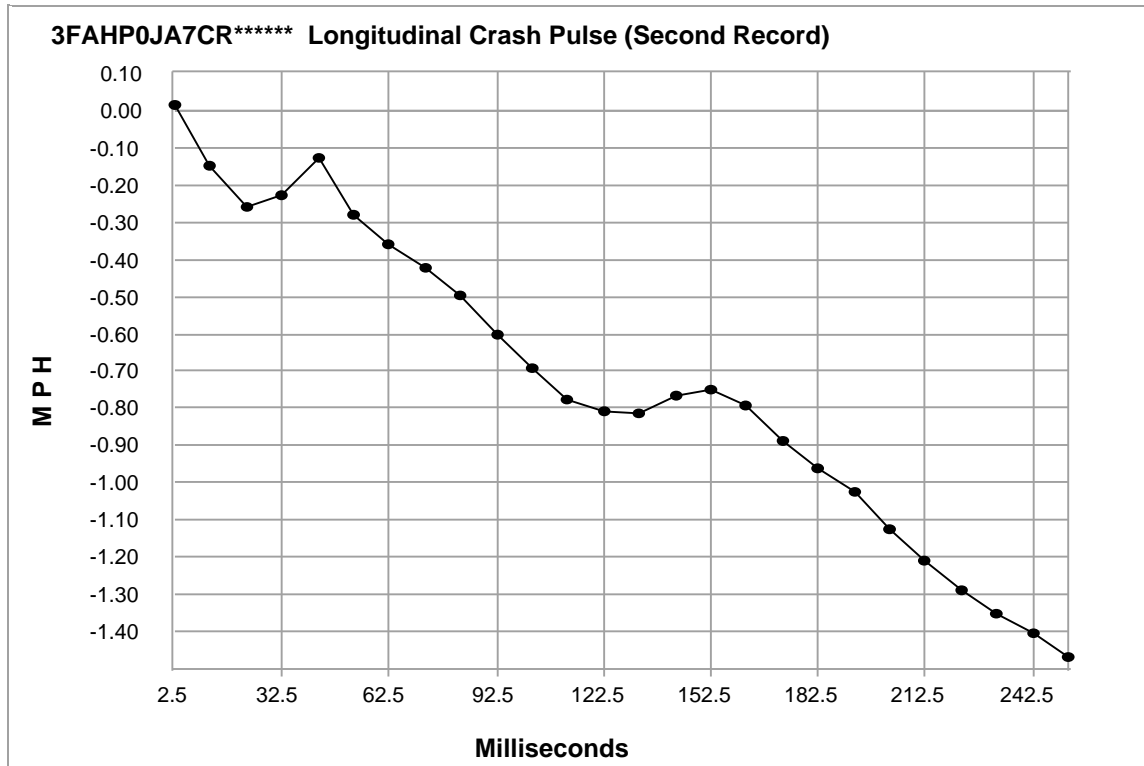
**Pre-Crash Data -5 to 0 sec [2 samples/sec] (Second Record)**

<b>Times (sec)</b>	<b>Speed vehicle indicated MPH [km/h]</b>	<b>Accelerator pedal, % full</b>	<b>Service brake, on/off</b>	<b>Engine RPM</b>	<b>ABS activity (engaged, non-engaged)</b>	<b>Stability control (engaged, non-engaged)</b>	<b>Traction Control via Brakes (engaged, non-engaged)</b>	<b>Traction Control via Engine (engaged, non-engaged)</b>
- 5.0	18.0 [29.0]	0	On	1,100	non-engaged	non-engaged	non-engaged	non-engaged
- 4.5	16.8 [27.0]	0	Off	1,000	non-engaged	non-engaged	non-engaged	non-engaged
- 4.0	16.2 [26.0]	10	Off	900	non-engaged	non-engaged	non-engaged	non-engaged
- 3.5	15.5 [25.0]	13	Off	1,300	non-engaged	non-engaged	non-engaged	non-engaged
- 3.0	16.2 [26.0]	14	Off	1,500	non-engaged	non-engaged	non-engaged	non-engaged
- 2.5	16.2 [26.0]	0	Off	1,400	non-engaged	non-engaged	non-engaged	non-engaged
- 2.0	15.5 [25.0]	0	Off	1,200	non-engaged	non-engaged	non-engaged	non-engaged
- 1.5	15.5 [25.0]	3	Off	1,300	non-engaged	non-engaged	non-engaged	non-engaged
- 1.0	15.5 [25.0]	24	Off	1,500	non-engaged	non-engaged	non-engaged	non-engaged
- 0.5	16.8 [27.0]	38	Off	2,000	non-engaged	non-engaged	non-engaged	non-engaged
0.0	17.4 [28.0]	34	Off	1,700	non-engaged	non-engaged	engaged	non-engaged

**Pre-Crash Data -5 to 0 sec [10 samples/sec] (Second Record)**

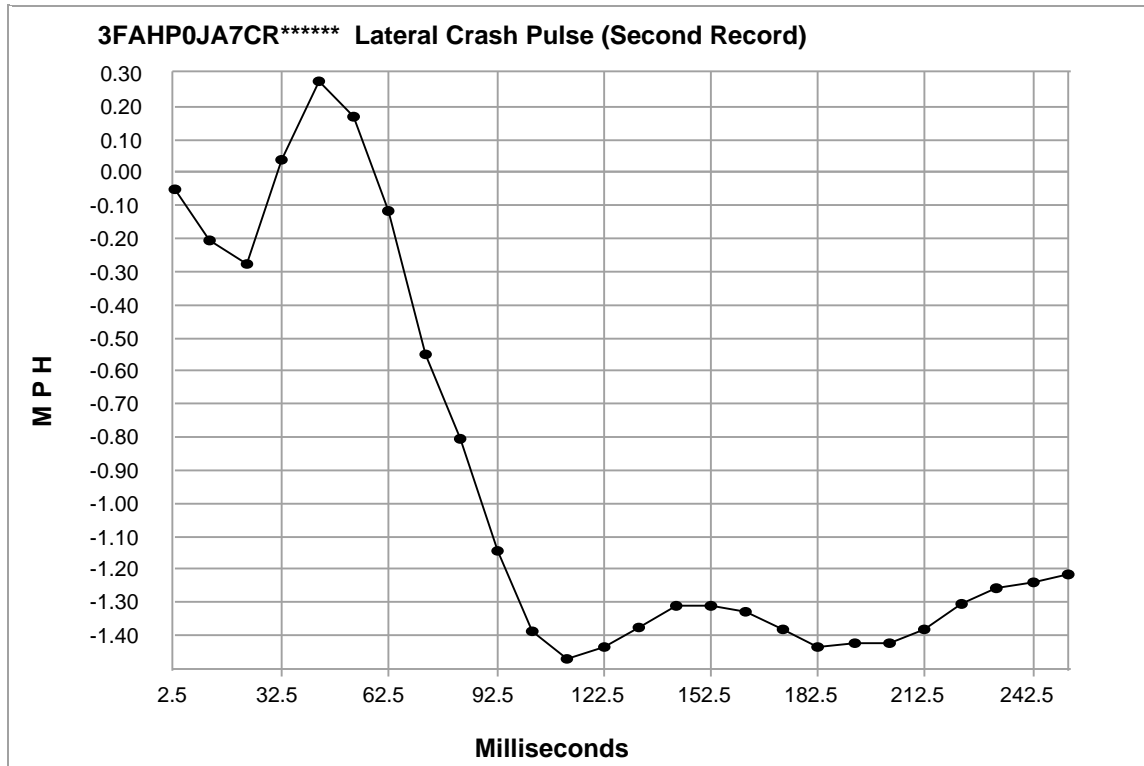
Times (sec)	Steering Wheel Angle (degrees)	Stability Control Lateral Acceleration (g)	Stability Control Longitudinal Acceleration (g)	Stability Control Yaw Rate (deg/sec)
- 5.0	-69.1	-0.131	-0.015	-10.87
- 4.9	-68.8	-0.221	-0.007	-10.0
- 4.8	-70.0	-0.201	-0.025	-10.0
- 4.7	-71.5	-0.192	-0.024	-10.12
- 4.6	-75.6	-0.212	-0.057	-9.87
- 4.5	-81.5	-0.209	-0.035	-10.62
- 4.4	-84.3	-0.201	-0.027	-11.87
- 4.3	-89.5	-0.218	-0.056	-11.62
- 4.2	-96.0	-0.245	-0.063	-11.87
- 4.1	-103.8	-0.301	-0.029	-13.5
- 4.0	-108.2	-0.295	-0.047	-14.37
- 3.9	-108.9	-0.236	-0.043	-15.62
- 3.8	-108.5	-0.258	-0.07	-15.25
- 3.7	-106.0	-0.228	-0.016	-15.0
- 3.6	-100.1	-0.241	0.08	-14.62
- 3.5	-90.9	-0.251	0.004	-13.87
- 3.4	-84.0	-0.212	0.012	-12.25
- 3.3	-79.1	-0.152	0.019	-11.37
- 3.2	-77.9	-0.134	0.007	-10.62
- 3.1	-84.3	-0.174	0.039	-10.87
- 3.0	-93.3	-0.259	0.004	-12.0
- 2.9	-99.5	-0.278	0.017	-13.25
- 2.8	-104.6	-0.261	0.002	-14.37
- 2.7	-106.9	-0.322	-0.008	-15.0
- 2.6	-106.0	-0.291	-0.026	-15.0
- 2.5	-105.6	-0.227	-0.017	-15.37
- 2.4	-106.1	-0.219	-0.026	-14.25
- 2.3	-108.5	-0.288	-0.058	-13.75
- 2.2	-113.3	-0.142	-0.064	-14.62
- 2.1	-114.2	-0.302	-0.036	-16.37
- 2.0	-110.1	-0.177	-0.108	-15.5
- 1.9	-107.0	-0.224	-0.064	-14.62
- 1.8	-107.9	-0.27	0.057	-14.75
- 1.7	-110.9	-0.291	0.039	-13.87
- 1.6	-118.9	-0.261	0.017	-16.0
- 1.5	-134.3	-0.343	-0.073	-16.37
- 1.4	-144.8	-0.365	-0.005	-19.0
- 1.3	-148.6	-0.344	0.014	-20.87
- 1.2	-150.8	-0.418	0.003	-20.25
- 1.1	-161.4	-0.369	0.081	-20.75
- 1.0	-175.2	-0.481	0.079	-23.12
- 0.9	-191.1	-0.559	0.105	-24.62
- 0.8	-209.6	-0.428	-0.028	-28.5
- 0.7	-221.8	-0.509	-0.068	-29.37
- 0.6	-226.2	-0.469	-0.029	-28.5
- 0.5	-227.6	-0.572	0.094	-30.37
- 0.4	-225.6	-0.551	0.042	-34.25
- 0.3	-225.0	-0.507	-0.029	-37.62
- 0.2	-220.7	-0.571	-0.015	-37.87
- 0.1	-202.7	-0.49	0.033	-36.12
0.0	-174.5	-2.0	2.0	-53.37





**Longitudinal Crash Pulse (Second Record)**

Time (msec)	Delta-V, longitudinal (MPH)	Delta-V, longitudinal (km/h)
2.5	0.02	0.03
12.5	-0.15	-0.24
22.5	-0.26	-0.42
32.5	-0.23	-0.36
42.5	-0.13	-0.21
52.5	-0.28	-0.45
62.5	-0.36	-0.57
72.5	-0.42	-0.68
82.5	-0.50	-0.80
92.5	-0.60	-0.97
102.5	-0.69	-1.12
112.5	-0.78	-1.25
122.5	-0.81	-1.30
132.5	-0.81	-1.31
142.5	-0.77	-1.24
152.5	-0.75	-1.20
162.5	-0.79	-1.28
172.5	-0.89	-1.43
182.5	-0.96	-1.55
192.5	-1.03	-1.65
202.5	-1.13	-1.81
212.5	-1.21	-1.95
222.5	-1.29	-2.07
232.5	-1.35	-2.17
242.5	-1.41	-2.26
252.5	-1.47	-2.37



**Lateral Crash Pulse (Second Record)**

Time (msec)	Delta-V, lateral (MPH)	Delta-V, lateral (km/h)
2.5	-0.05	-0.08
12.5	-0.21	-0.33
22.5	-0.27	-0.44
32.5	0.04	0.06
42.5	0.28	0.44
52.5	0.17	0.27
62.5	-0.11	-0.18
72.5	-0.55	-0.89
82.5	-0.80	-1.29
92.5	-1.14	-1.84
102.5	-1.38	-2.23
112.5	-1.47	-2.37
122.5	-1.43	-2.31
132.5	-1.38	-2.22
142.5	-1.31	-2.11
152.5	-1.31	-2.11
162.5	-1.33	-2.13
172.5	-1.38	-2.22
182.5	-1.43	-2.31
192.5	-1.43	-2.29
202.5	-1.42	-2.29
212.5	-1.38	-2.22
222.5	-1.30	-2.10
232.5	-1.26	-2.02
242.5	-1.24	-1.99
252.5	-1.21	-1.95

## Hexadecimal Data

Data that the vehicle manufacturer has specified for data retrieval is shown in the hexadecimal data section of the CDR report. The hexadecimal data section of the CDR report may contain data that is not translated by the CDR program. The control module contains additional data that is not retrievable by the CDR system.

04 00 00 00

42 45 35 33 2D 31 34 42 33 32 31 2D 42 44 00 00 00 00 00 00 00 00 00 00

33 30 32 31 31 38 35 31 30 30 30 30 30 30 30

42 4C 38 34 2D 31 34 43 30 32 38 2D 41 42 00 00 00 00 00 00 00 00 00 00

14 6B 7E AD 00 00 00 00 00 00 00 00 00 00 00 00

A8 51 3C 02 00 00 00 00 00 00 00 00 00 00 00 00

14 6C 07 7C 00 00 00 00 00 00 00 00 00 00 00 00

14 6B 21 B5 00 00 00 00 00 00 00 00 00 00 00 00

00 60 59 02 00 00 00 00 00 00 00 00 00 00 00 00

14 6A 46 C2 00 00 00 00 00 00 00 00 00 00 00 00

33 46 41 48 50 30 4A 41 37 43 52 2A 2A 2A 2A 2A 2A

33 46 41 48 50 30 4A 41 37 43 52 2A 2A 2A 2A 2A 2A 00 00 00 00 00 00 00

## Event Record 1

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37 06 00 00 38 06 00 00 6E 28 06 00 57 00 00 00 6C E8 FF FF 16 27 00 00 19 59 F9
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F9 FF 19 A5 F9 FF 81 A8 F9 FF 33 AD F9 FF C6 B0 F9 FF 71 B5 F9 FF 37 B7 F9 FF 93
BA F9 FF 14 BD F9 FF 3F BF F9 FF F4 BF F9 FF 2A BF F9 FF C8 BE F9 FF B3 BE F9 FF
EF BF F9 FF EC C0 F9 FF B4 C0 F9 FF E1 BF F9 FF 85 BE F9 FF CB BD F9 FF C6 BC F9
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A3 22 9A 22 C3 22 E2 22 D9 22 BB 22 6B 22 D1 21 68 21 42 21 2C 21 C2 20 38 20 99
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1C 24 E1 23 C5 23 91 23 50 23 02 23 D6 22 CF 22 D3 22 EC 22 27 23 83 23 C8 23 F9
23 05 24 C5 23 6B 23 2D 23 D2 07 C8 07 B6 07 BF 07 B6 07 96 07 90 07 AC 07 64 07
90 07 09 08 F7 07 E1 07 87 07 CB 07 DE 07 D3 07 21 08 1F 08 39 08 B4 07 8C 07 B3
07 2E 08 FA 07 B3 07 C1 07 F1 07 7A 07 C1 07 C9 07 B7 07 B8 07 97 07 AD 07 B5 07
98 07 91 07 B3 07 A1 07 A5 07 8A 07 C0 07 20 08 D4 07 DC 07 E3 07 D7 07 F7 07 D4
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05 95 05 E6 05 42 07 4D 07 F3 06 07 07 10 07 FC 06 FF 06 07 07 F6 06 DB 06 A3 06
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40 74 40 4F 40 BF 40 F1 40 9A 40 EB 3F 42 40 9A 40 8D 40 E5 40 10 40 EB 3F E4 3E
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